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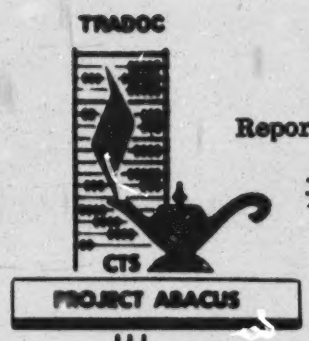
An electronics graphic symbol set for on-line construction of electrical and electronics schematic diagrams is described. Specific procedures involving off-line and on-line activities are presented for the development and entry of schematic diagrams utilizing a stored set of symbols. An example of the commands and coding required for the construction of diagrams is provided. (Author)



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AN ON-LINE ELECTRONICS GRAPHICS SYMBOL SET FOR THE PLATO IV SYSTEM

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This report has been reviewed and is approved.

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An electronics graphics symbol set for on-line construction of electrical and electronics schematic diagrams is described. Specific procedures involving off-line and on-line activities are presented for the development and entry of schematic diagrams utilizing a stored set of symbols. An example of the commands and coding required for the construction of diagrams is provided.

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FOREWORD

The procedure described in this report for generating diagrams which include electronics graphics symbols offers a substantial reduction in the time required to enter schematic diagrams into the PLATO IV system. As additions to the initial set of symbols in this report are developed, appropriate documentation will be made available to interested users.

The work reported herein is supported by a program sponsored by the Advanced Research Projects Agency (ARPA) to evaluate the PLATO IV system for use in training oriented to the needs of the Armed Services.

The guidance provided to the authors of this report by the Computer Based Education Research Laboratory at the University of Illinois is gratefully acknowledged.

G. B. HOWARD
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PURPOSE

The purpose of this report is to provide documentation on the contents and use of the electronics symbol set prepared for use in course materials that are being prepared for the Computerized Training System Project at the US Army Signal Center and School, Fort Monmouth, New Jersey. These lessons are to be implemented on the PLATO IV computer assisted instruction system resident at the University of Illinois, Urbana, Illinois. The report is designed to be used by instructional programmers, programmers, instructional entry specialists and others interested in developing on-line electronic schematics for use on the PLATO IV computer system. It is assumed that the users of this report are experienced in the use of the PLATO IV system and the TUTOR language.

INTRODUCTION

When teaching maintenance and repair of electronic equipment, it is essential to the teaching process that circuit schematics be used. The plasma display terminal and the PLATO IV computer system make it feasible to put simplified schematics on line. However, if a symbol must be constructed each time it is used, this would reflect adversely upon the practicality of the extensive use of on-line graphics by requiring; a higher degree of skill on the part of the instructional program entry specialist: more time to input the schematics; and excessive use of lesson material space within the computer. A set of commonly-used electronics symbols was developed to alleviate these problems. The symbol set is resident in a character set in lesson MON1 on the PLATO IV computer system. The symbols may be examined by signing into lesson MON12. The use of the symbol set and the TUTOR language commands "at", "draw", "write", and "join" permits the schematic to be drawn during the execution of the lesson.

The symbols in the set are character oriented with each symbol occupying from two to six contiguous character spaces. The character spaces are configured typically as shown by the symbols on pages 5, 7, 24, 30, and 43. Each symbol has an orientation or reference point that is addressed in the tag of the "at" command. This reference point is indicated by a solid square on the symbol layout. When positioning the symbol either coarse or fine grid coordinates may be specified in the tag of the "at" command.

The symbols conform, within the limits of the display matrix, to the standards set forth by the American National Standards Institute document Y32.2, title "IEEE Standard and American National Standard Graphic Symbols for Electrical and Electronics Diagrams", November 1970, and adopted for mandatory use by the Department of Defense, September 1970. The symbol set must be considered the initial set and will be expanded as the need for additional symbols arises.

PROCEDURE

The procedure for producing on-line schematics is described in two parts. The first part describes how to prepare a schematic using the PLATO IV Display Planning Sheet (fig. 1). The second part describes the procedure for entering the schematic into a lesson.

Off-Line Preparation: The instructional programmer can use the PLATO IV Display Planning Sheet to lay out the schematics. The reference point on each symbol is used to orient the symbol within the schematic so that lines can be drawn using the coarse grid mode; and by referring to the desired symbol; the area occupied by that symbol can be quickly determined. For example, refer to symbol "h-batl", page 9. When the computer is given the following commands: "at 1015" followed by "join h-batl" the symbol will appear at row 10, column 15, and occupy character spaces 1015, 1016, 1115, and 1116. Figure 1 is an example of a schematic and its associated coding. Users of the electronics symbol character set must exercise care to assure that the symbol name used in the tag of the "join" command is exactly as specified.

On-Line Entry: The instructional program entry specialist will use the appropriate TUTOR authoring and editing commands and procedures to enter the schematics into the PLATO IV lessons. There are a number of ways available to use the symbol character set. Two will be described in this report. The first method can be used if the "use" code for MON1 is known. The "use" codes for MON1 and the lesson using the character set must be the same to use the "use" commands.

The instructional programmer will supply the instructional program entry specialist with a set of instructions. For example, if the schematic in figure 1 were in lesson MON14, the instructions would read as follows:

Lesson ID: MON14
Character Set: symbls
Use Code: cts

The instructional program entry specialist would sign into the designated course and lesson and enter the following commands:

```
charset      mon1, symbls (This command must be used to load the
    .                      character set into the terminal.)
    .
    .
lesson commands and text
    .
    .
use          mon1, symbols1  (These should be the last commands in
use          symbols2         the lesson.)
```

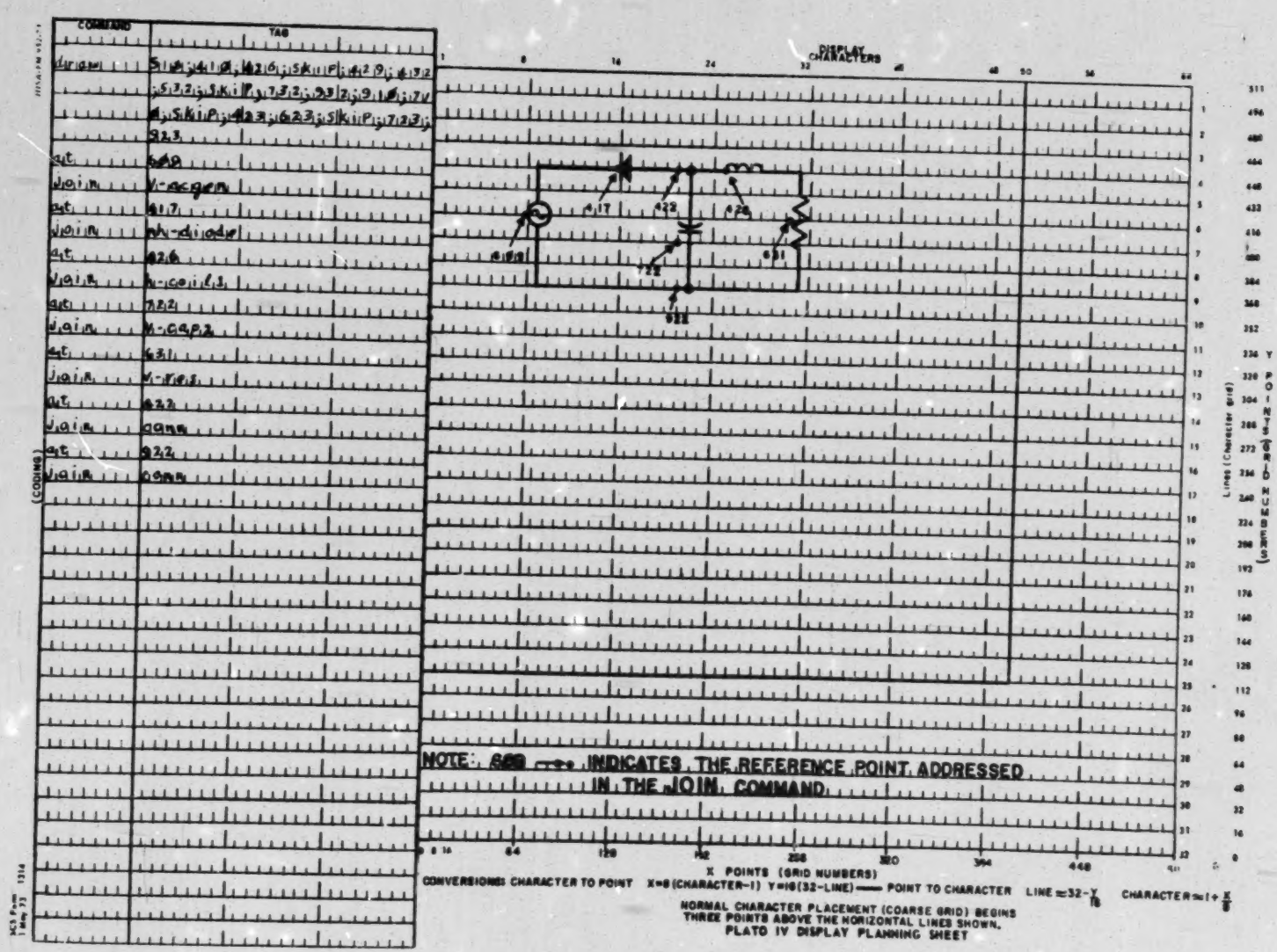

COMMAND
TAG
(CODING)
DISPLAY CHARACTERS
Lines (Character grid)
POINTS (GRID NUMBERS)
NOTE: 668 ⟶ INDICATES THE REFERENCE POINT ADDRESSED IN THE JOIN COMMAND.
X POINTS (GRID NUMBERS)
CONVERSIONS CHARACTER TO POINT X=8(CHARACTER-1) Y=16(32-LINE) —— POINT TO CHARACTER LINE=32-Y/16 CHARACTER=1+X/8
NORMAL CHARACTER PLACEMENT (COARSE GRID) BEGINS THREE POINTS ABOVE THE HORIZONTAL LINES SHOWN.
PLATO IV DISPLAY PLANNING SHEET

Figure 1

Blocks symbols1 and symbols2 have been set up with a "unit" for each symbol. This allows the command "join h-batl" to join the symbol shown on page 9. This is useful in that the programmer does not have to remember individual character assignments. A second method can be used by authors familiar with using the "font" mode.

As with method 1, instructions must be given to the instructional program entry specialist concerning lesson identification and character set. These instructions would read as follows:

```
Lesson ID;    MON14
Character Set: symbls
```

The instructional program entry specialist then signs into the designated lesson and enters this command.

```
charset      mon1, symbls
```

To construct a symbol the instructional program entry specialist uses the following procedure. For example to place a vertical resistor as shown on page 38 at screen position 1010 the following commands would be entered into the lesson:

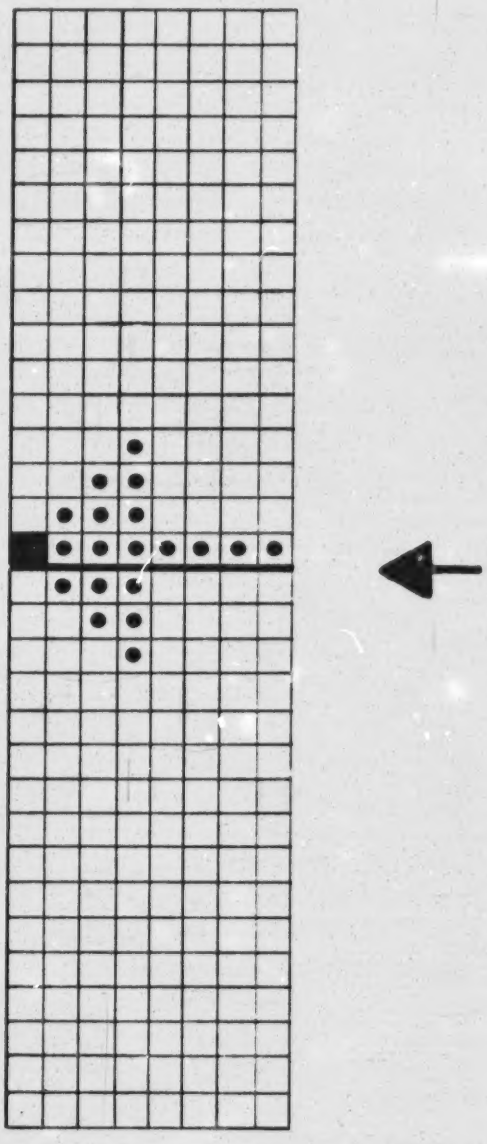
```
at      1010
write   "font" AB  "font"
        "font" CD  "font"
```

SCHEMATIC SYMBOLS

The following pages of this report provide a short description of the symbol, the exact symbol name to be used, a sample of the symbol, and the character dot matrix design of the symbol with the address point indicated. Figure 2, page 54 shows the symbols as they are displayed on a PLATO IV terminal. Figure 3, page 55 is a PLATO IV terminal display of symbols being used in a schematic.

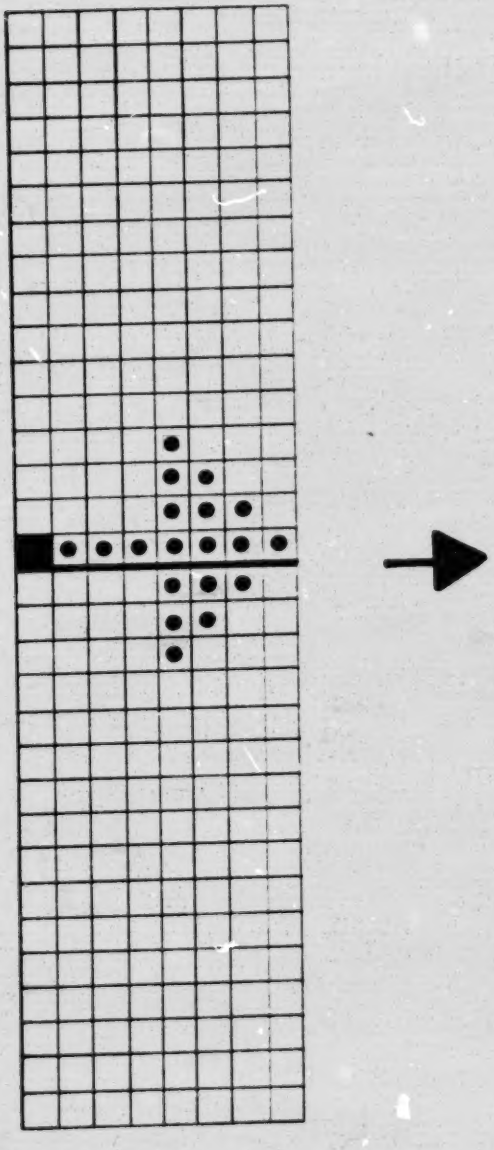
SYMBOL: horizontal arrow, left pointing

SYMBOL NAME: 1-arrow



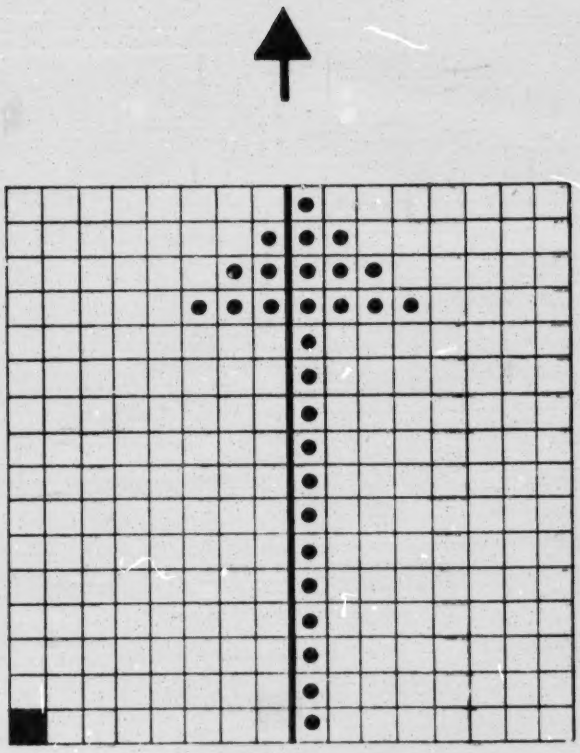
SYMBOL: horizontal arrow, right pointing

SYMBOL NAME: r-arrow



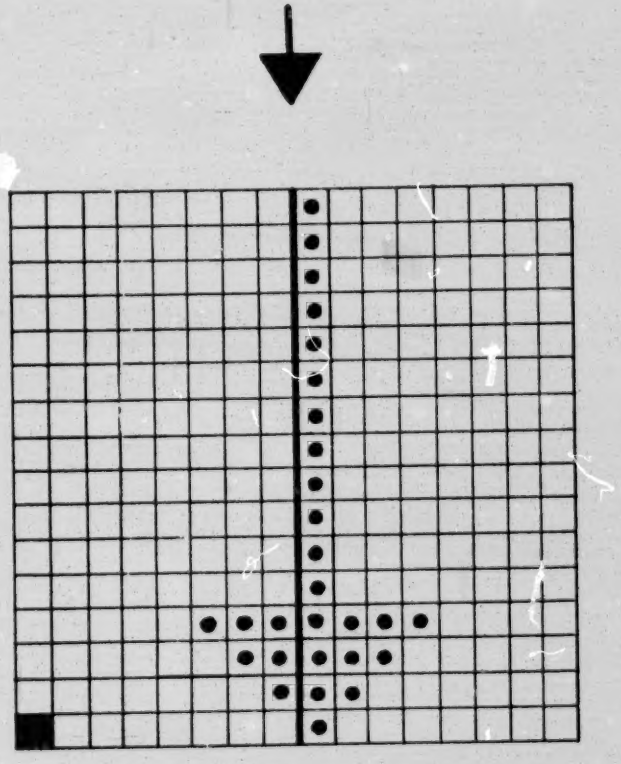
SYMBOL: vertical arrow pointing up

SYMBOL NAME: v-arrow1



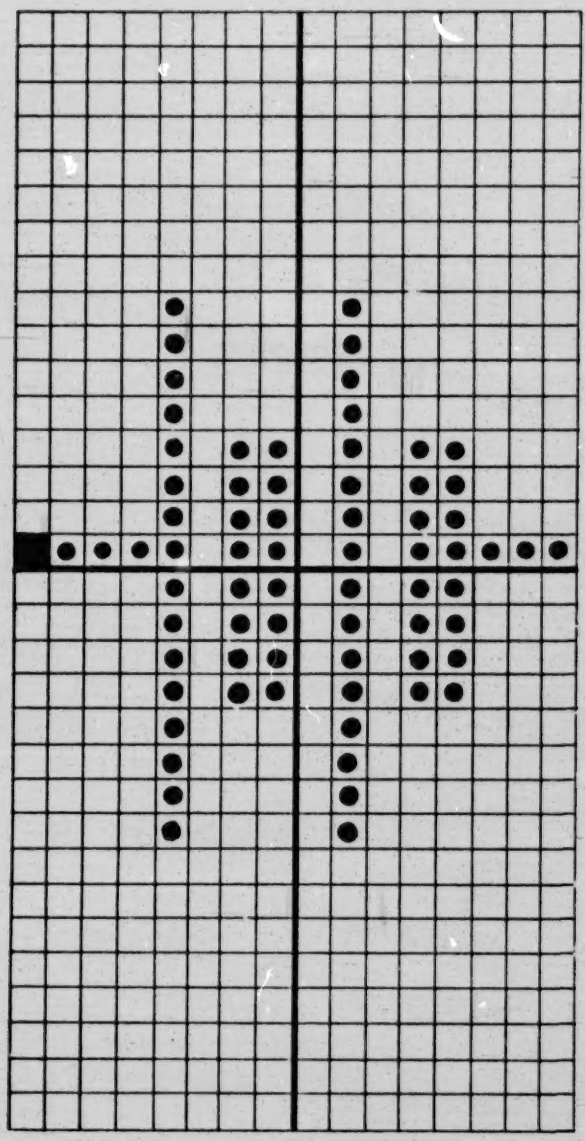
SYMBOL: vertical arrow pointing down

SYMBOL NAME: v-arrow2



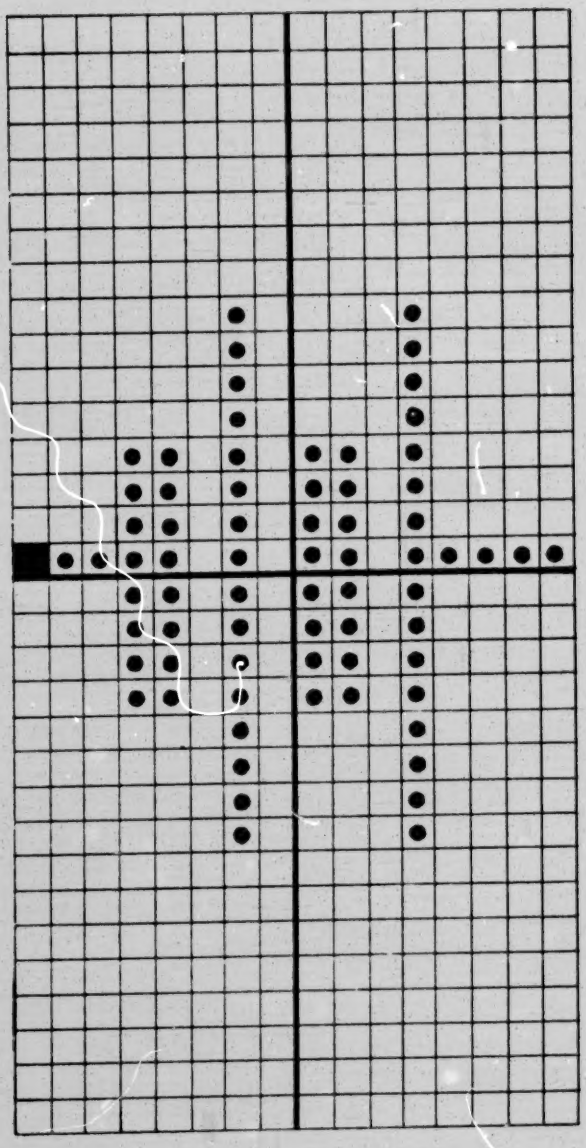
SYMBOL: horizontal battery, negative terminal right

SYMBOL NAME: h-bat1



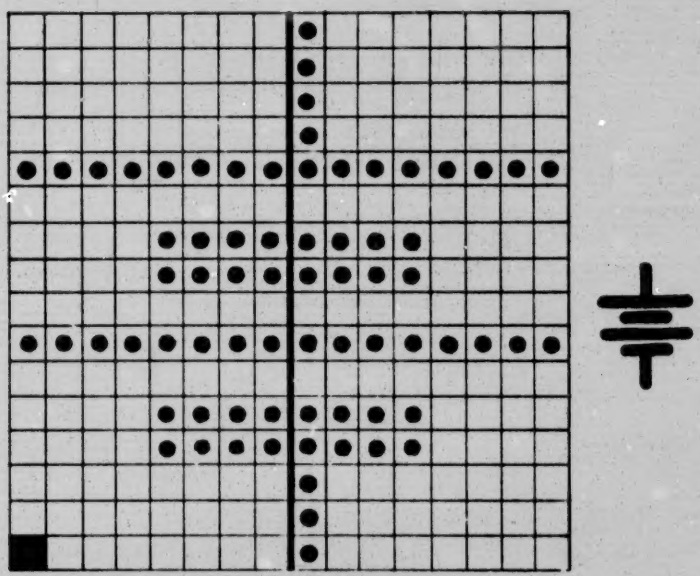
SYMBOL: horizontal battery, negative terminal left

SYMBOL NAME: h-bat2



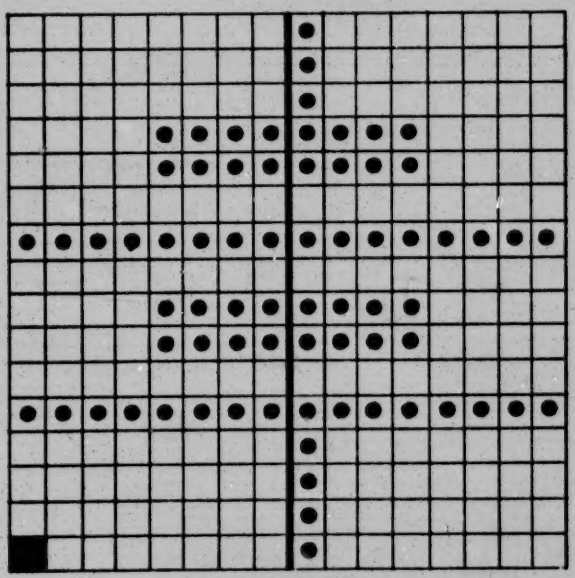
SYMBOL: vertical battery, negative terminal down

SYMBOL NAME: v-bat1



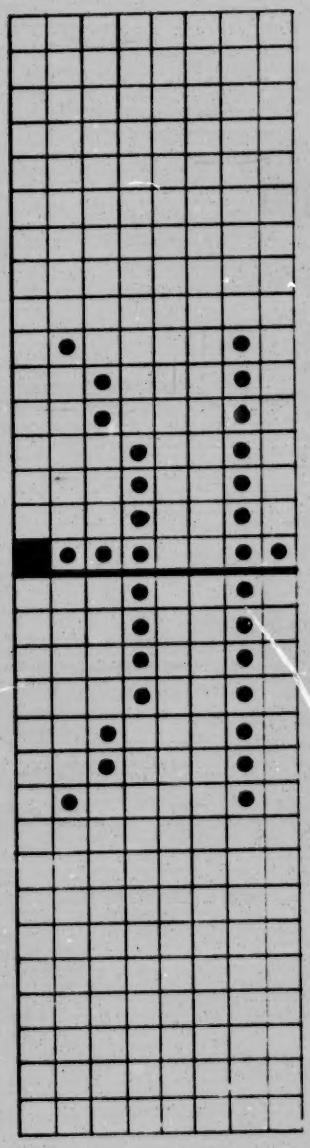
SYMBOL: vertical battery, negative terminal up

SYMBOL NAME: v-bat2



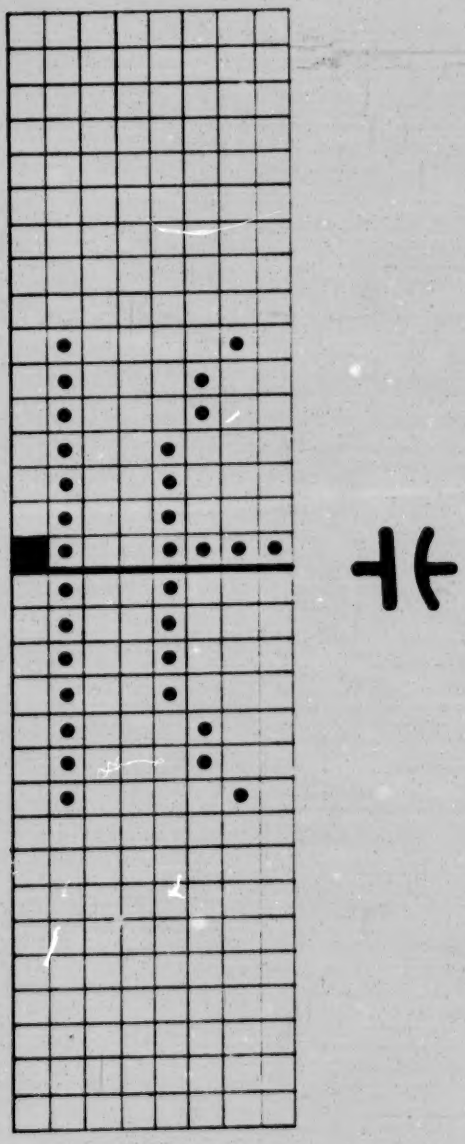
SYMBOL: horizontal capacitor, outside plate left

SYMBOL NAME: hl-cap



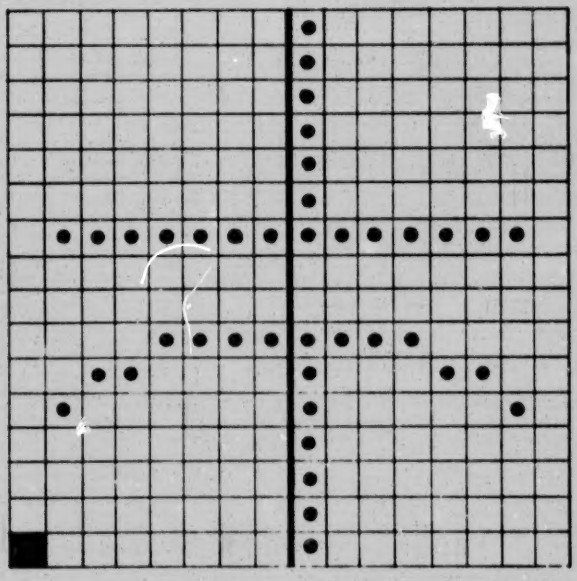
SYMBOL: horizontal capacitor, outside plate right

SYMBOL NAME: hr-cap



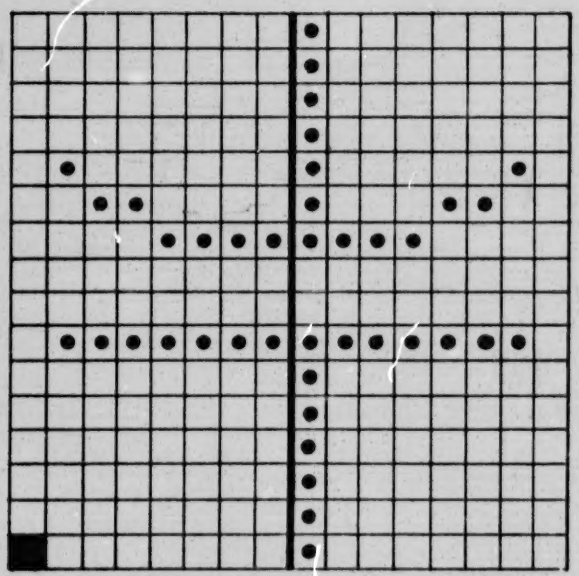
SYMBOL: vertical capacitor, outside plate down

SYMBOL NAME: v-cap1



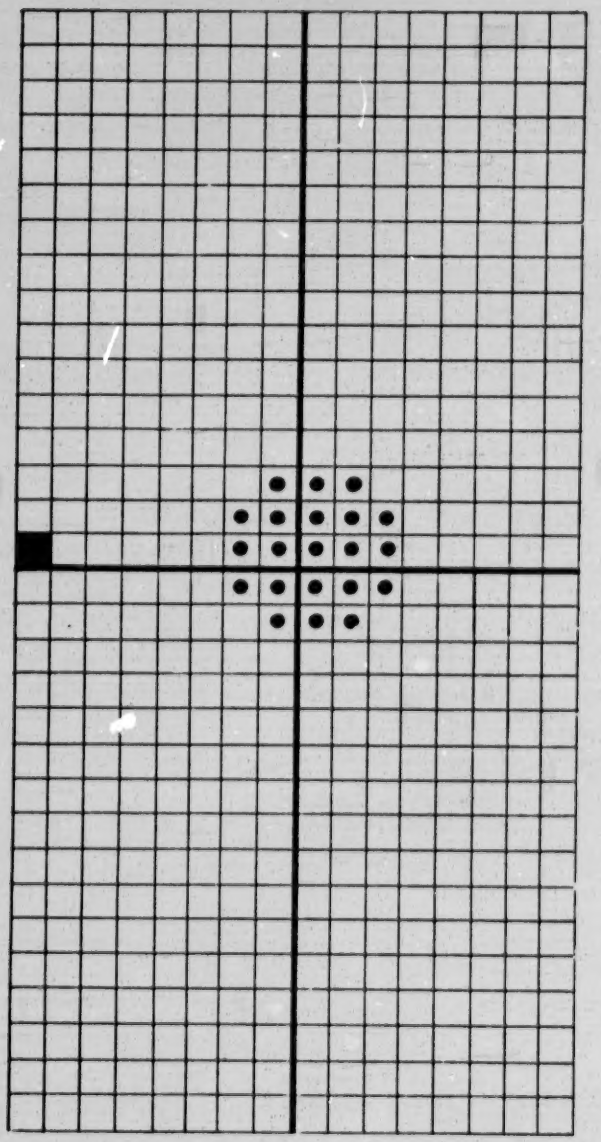
SYMBOL: vertical capacitor, outside plate up

SYMBOL NAME: v-cap2



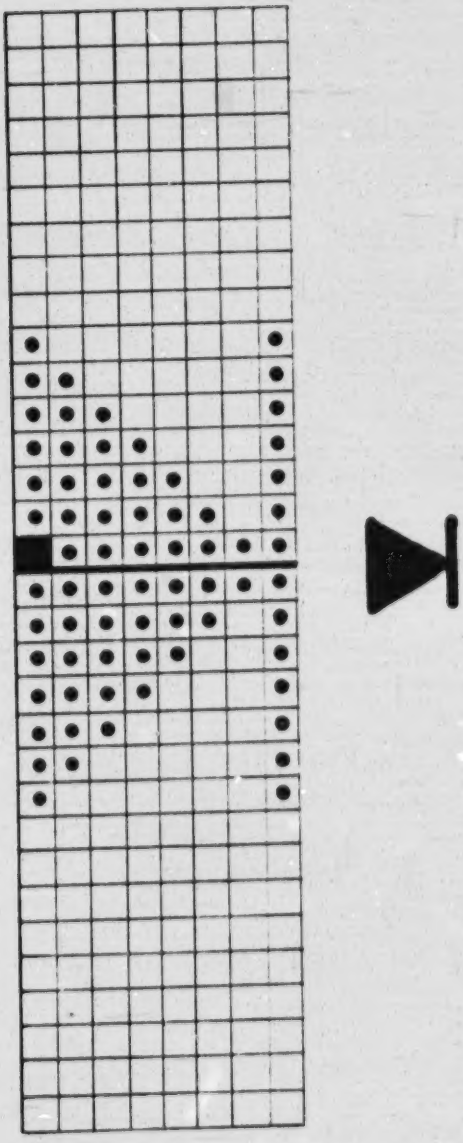
SYMBOL: circuit connection

SYMBOL NAME: conn



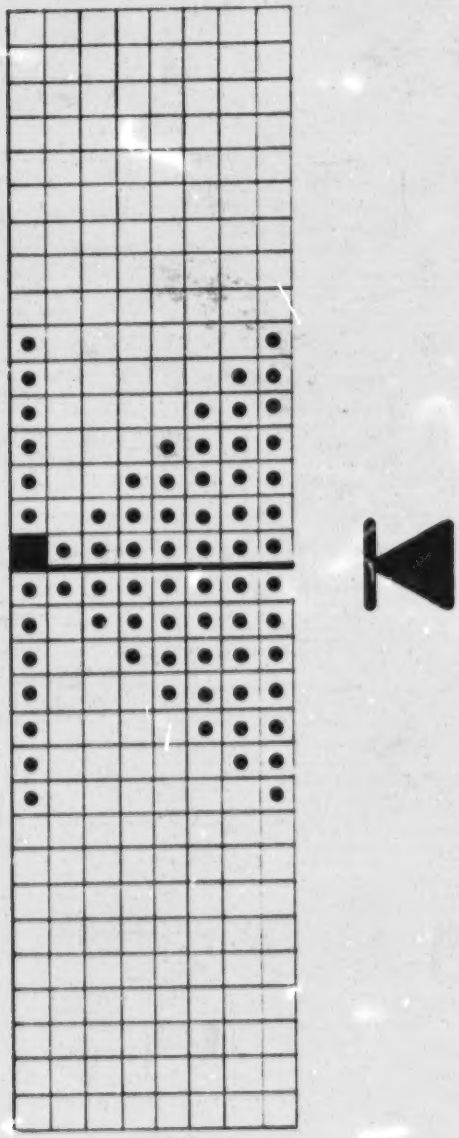
SYMBOL: horizontal solid state diode, cathode right

SYMBOL NAME: lh-diode



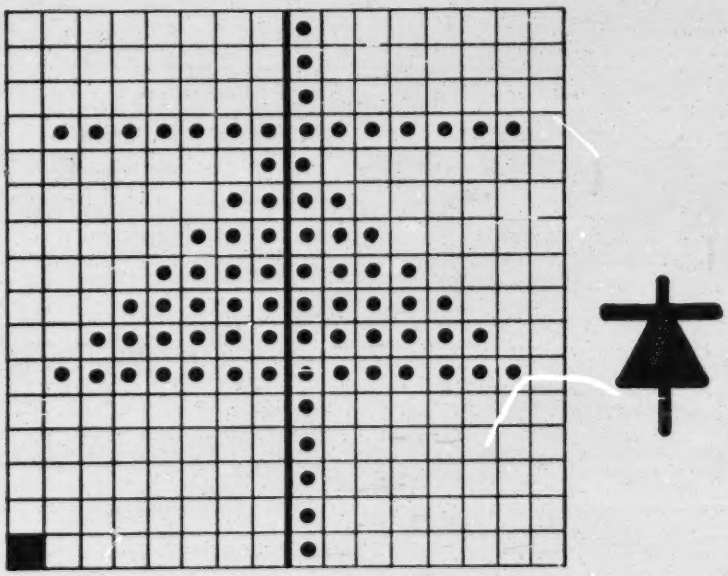
SYMBOL: horizontal solid state diode, cathode left

SYMBOL NAME: rh-diode



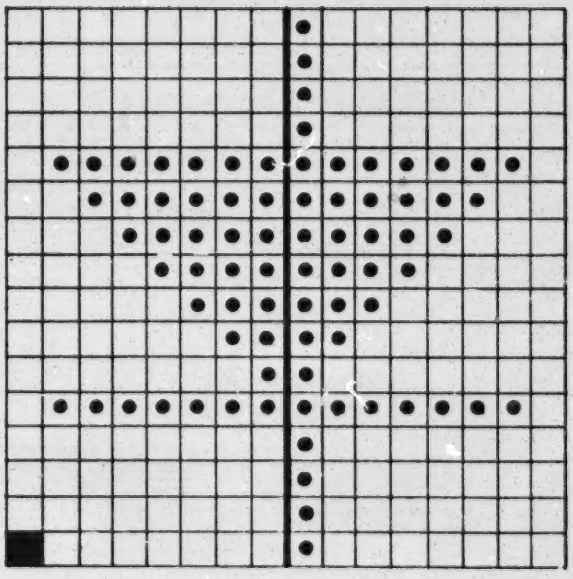
SYMBOL: vertical solid state diode, cathode up

SYMBOL NAME: v-diode1



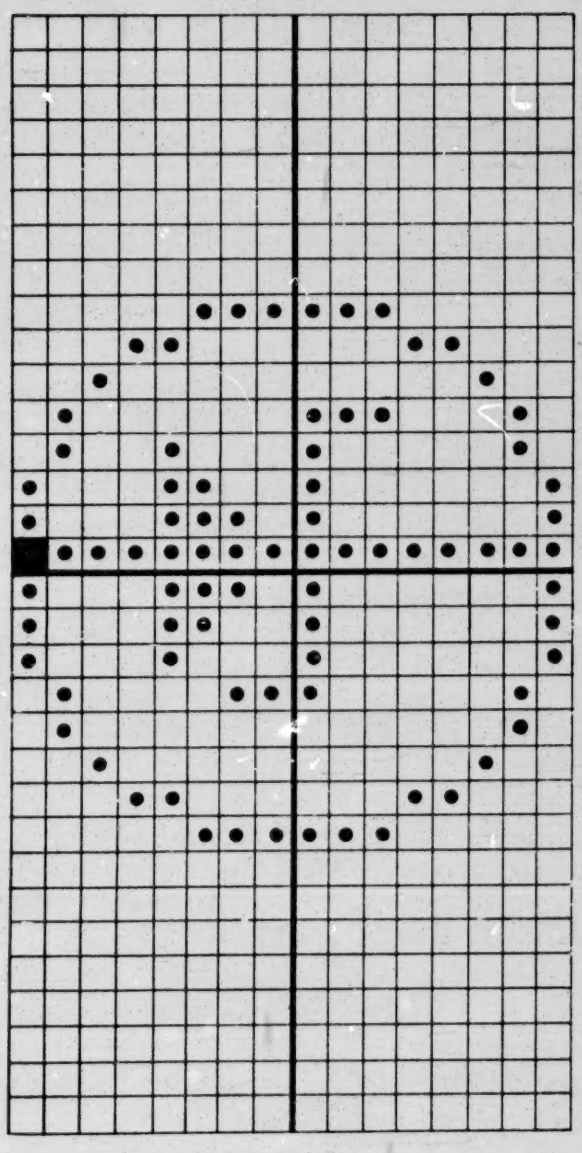
SYMBOL: vertical solid state diode, cathode down

SYMBOL NAME: v-diode2



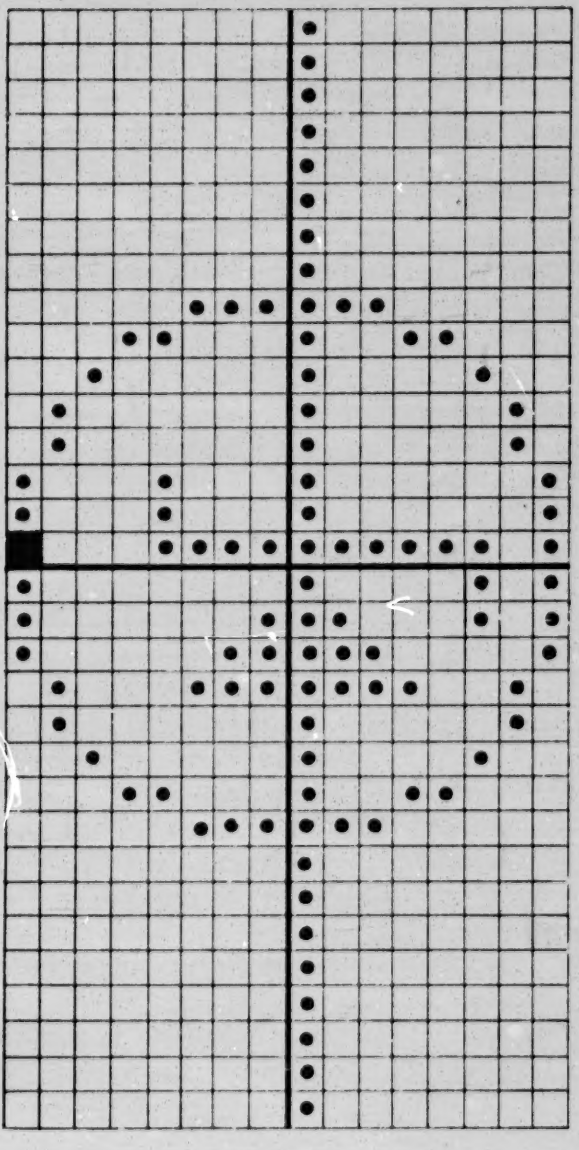
SYMBOL: horizontal zener diode

SYMBOL NAME: h-zdiode



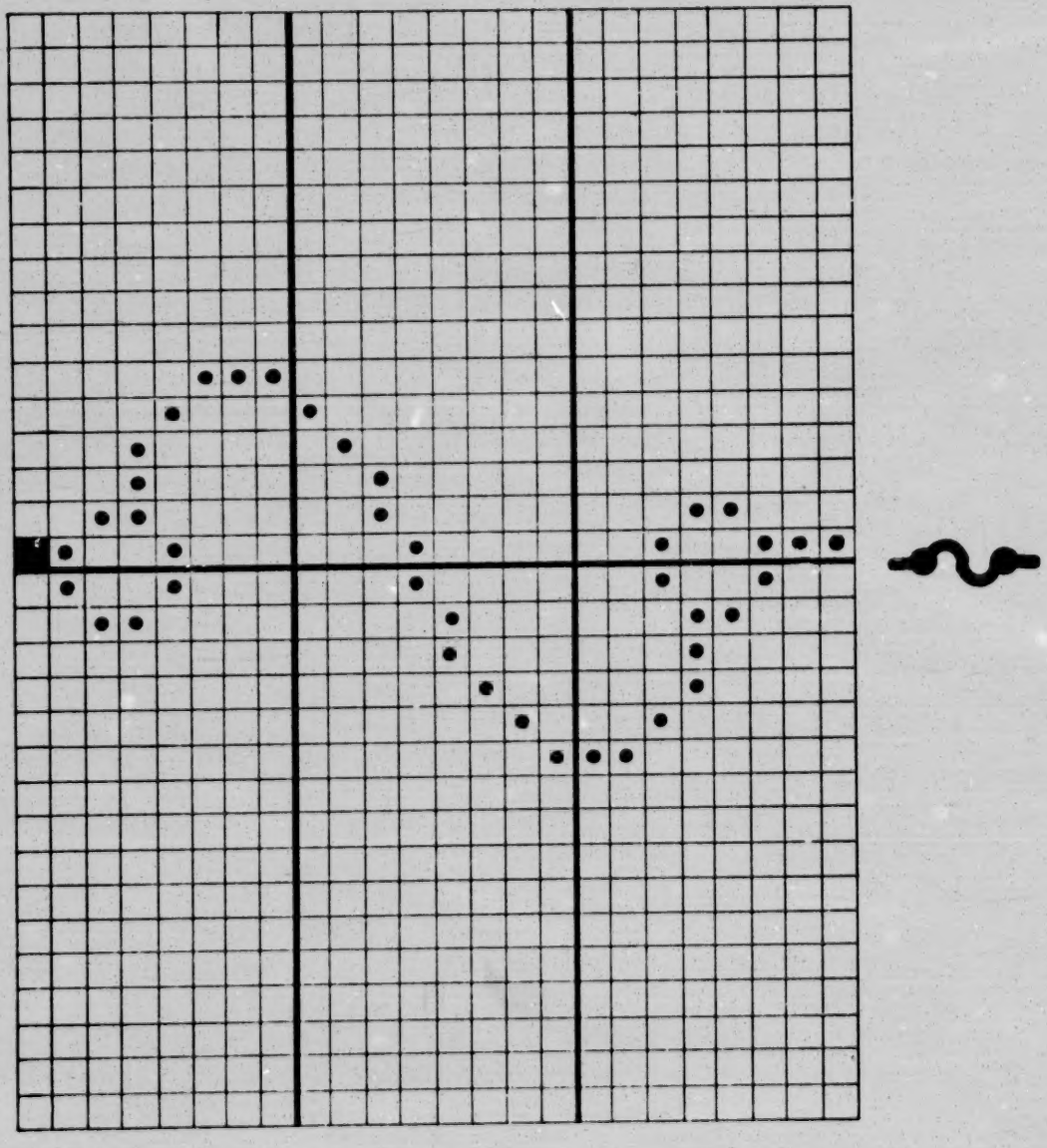
SYMBOL: vertical zener diode

SYMBOL NAME: vzdiode



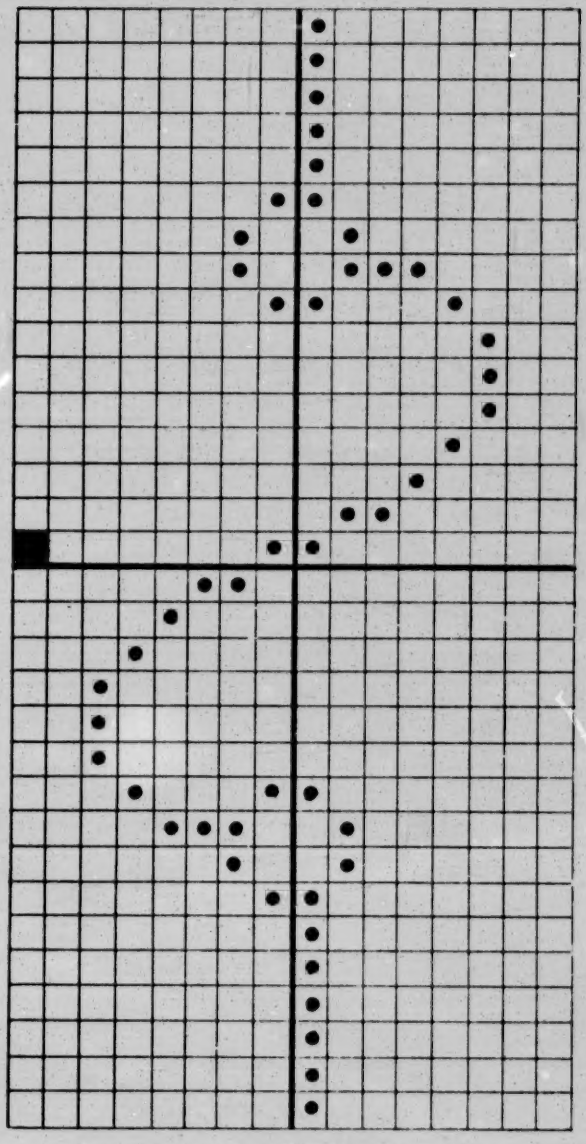
SYMBOL: horizontal fuse

SYMBOL NAME: h-fuse



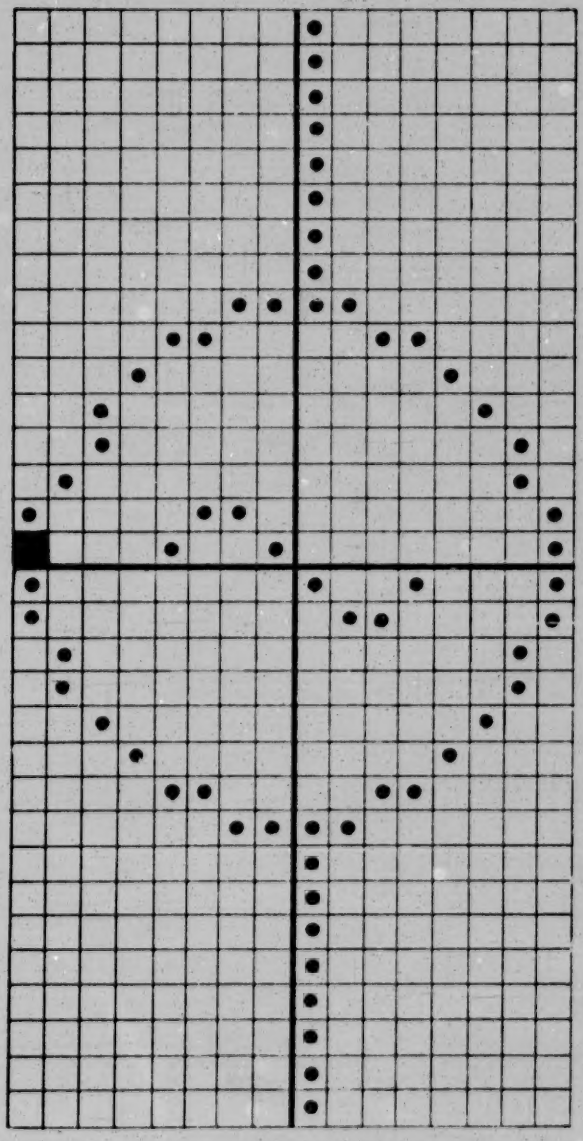
SYMBOL: vertical fuse

SYMBOL NAME: v-fuse



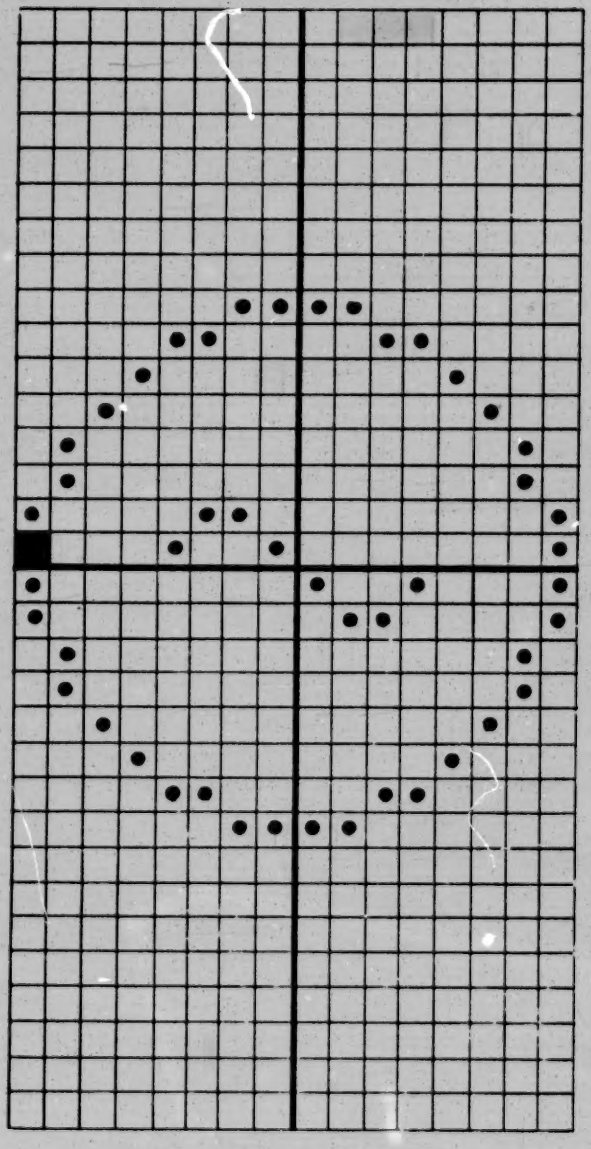
SYMBOL: vertical ac generator

SYMBOL NAME: v-acgen



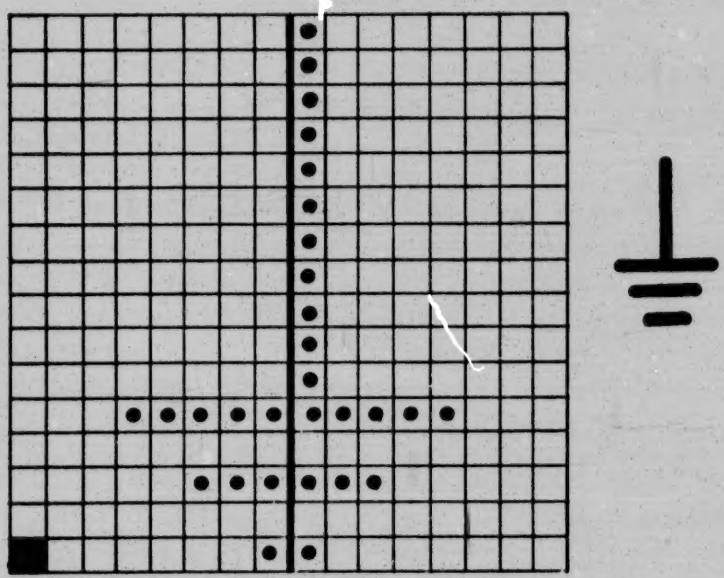
SYMBOL: horizontal ac generator

SYMBOL NAME: h-acgen



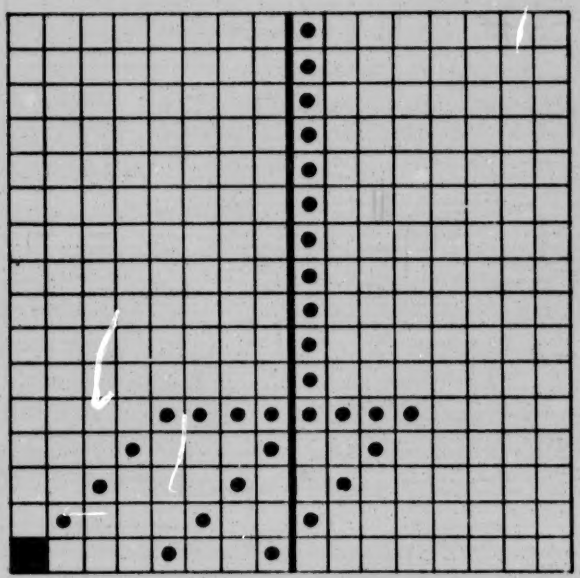
SYMBOL: ground

SYMBOL NAME: grd



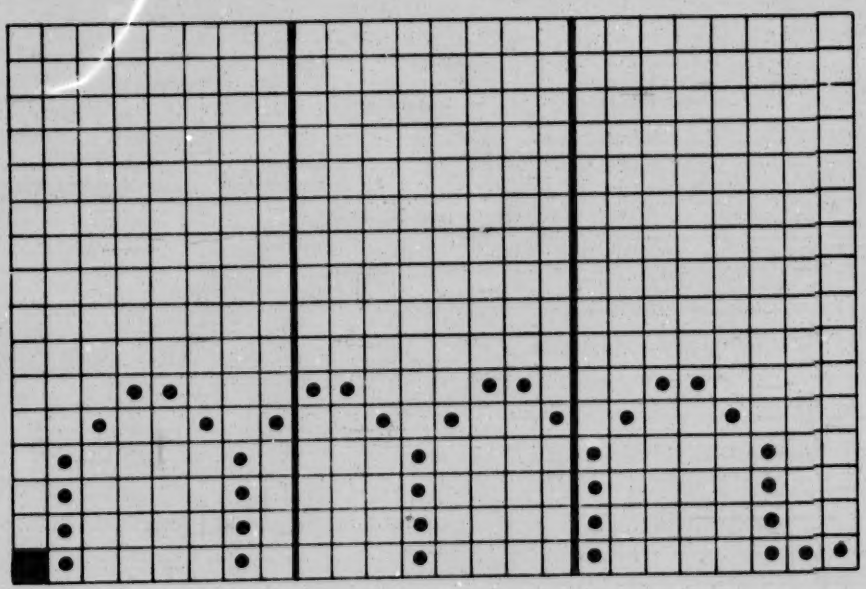
SYMBOL: chassis ground

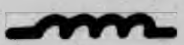
SYMBOL NAME: chsgrd



SYMBOL: horizontal inductor, coils up

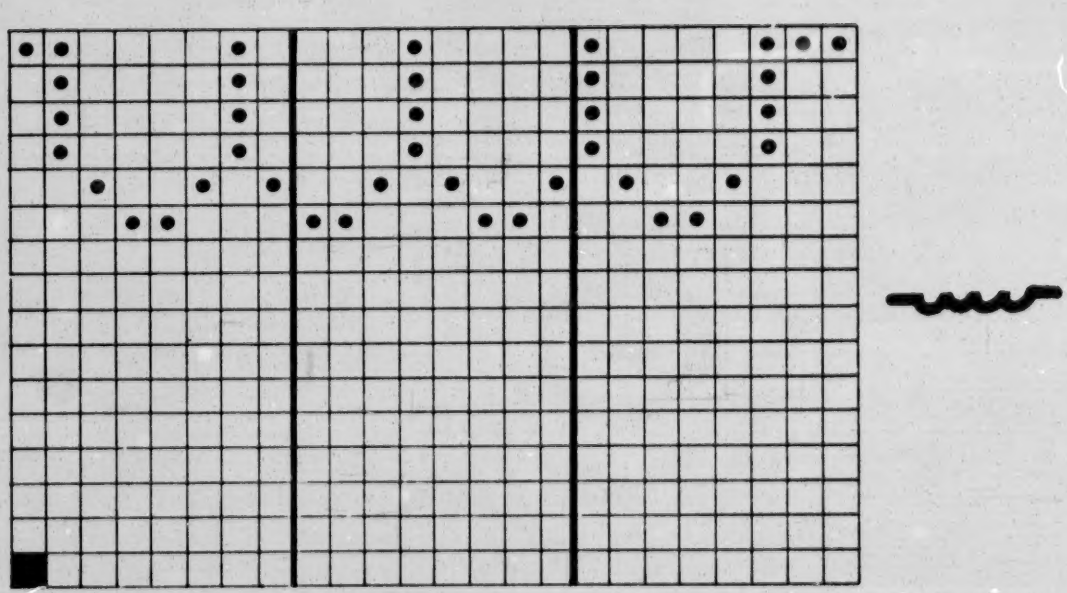
SYMBOL NAME: h-coil1





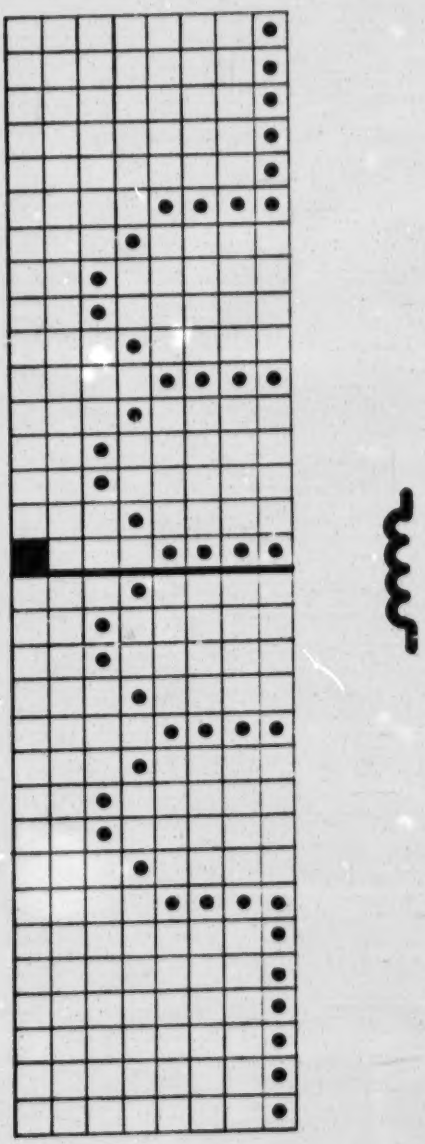
SYMBOL: horizontal inductor, coils down

SYMBOL NAME: h-coil2



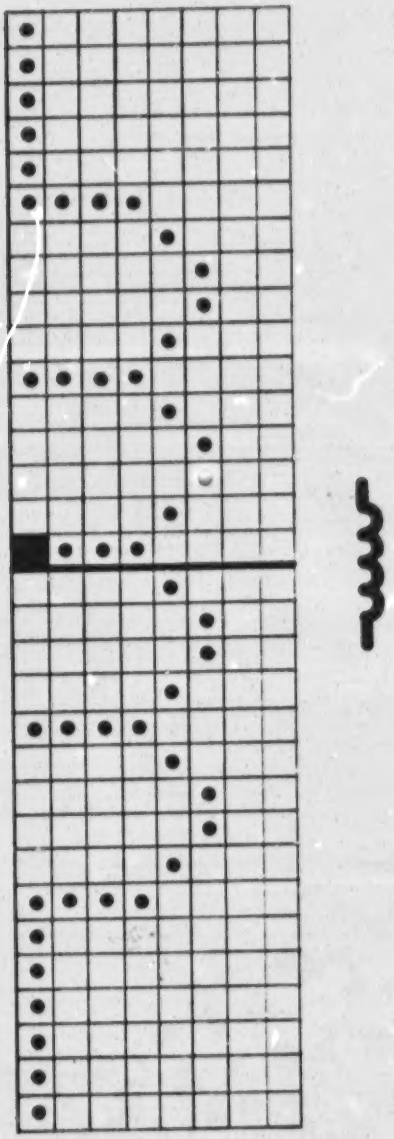
SYMBOL: vertical inductor, coils left

SYMBOL NAME: vl-coil



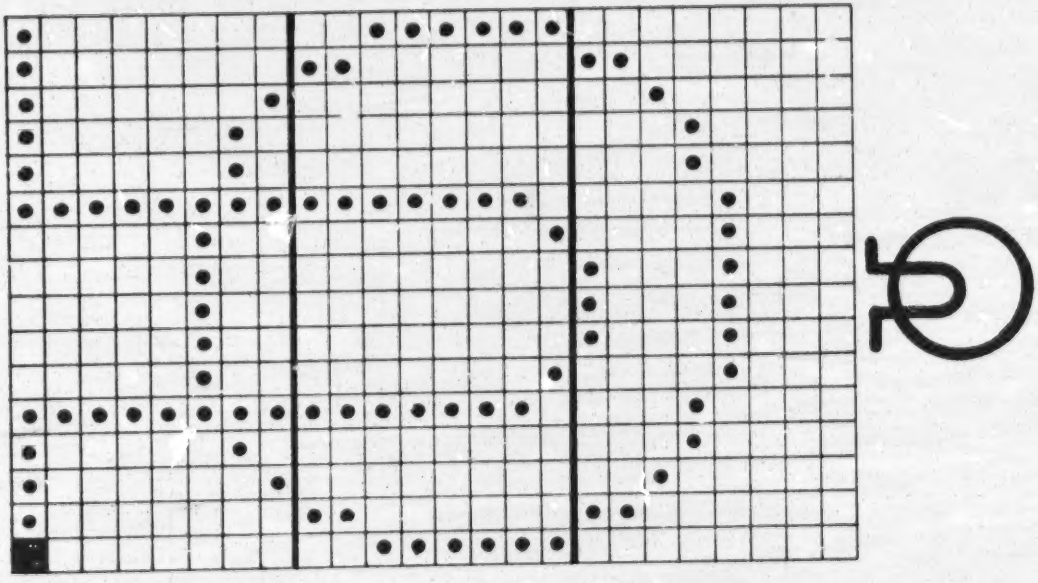
SYMBOL: vertical inductor, coils right

SYMBOL NAME: vr-coil



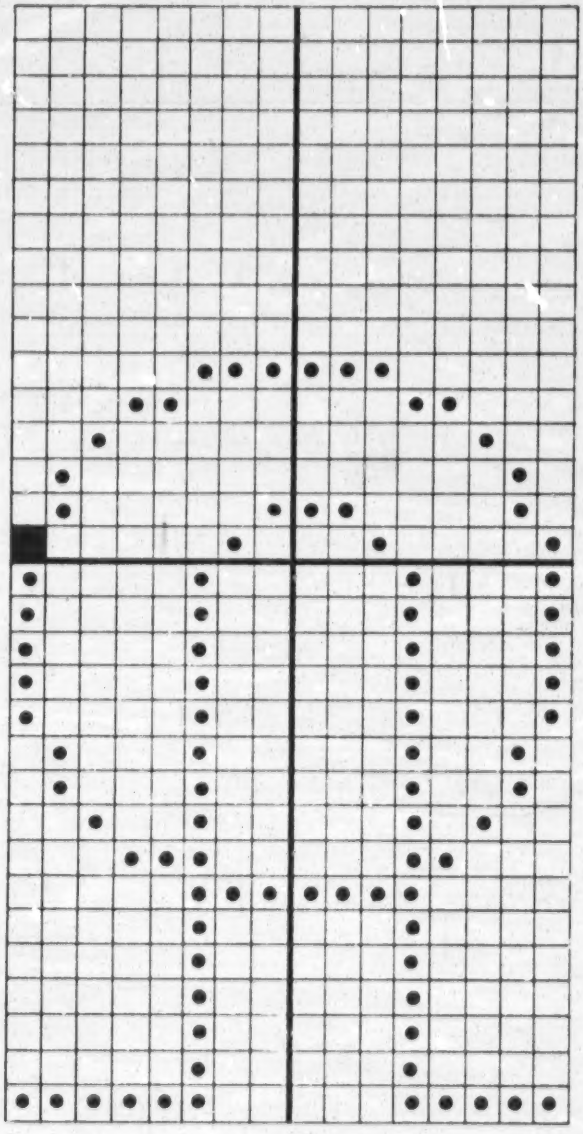
SYMBOL: vertical lamp

SYMBOL NAME: v-lamp



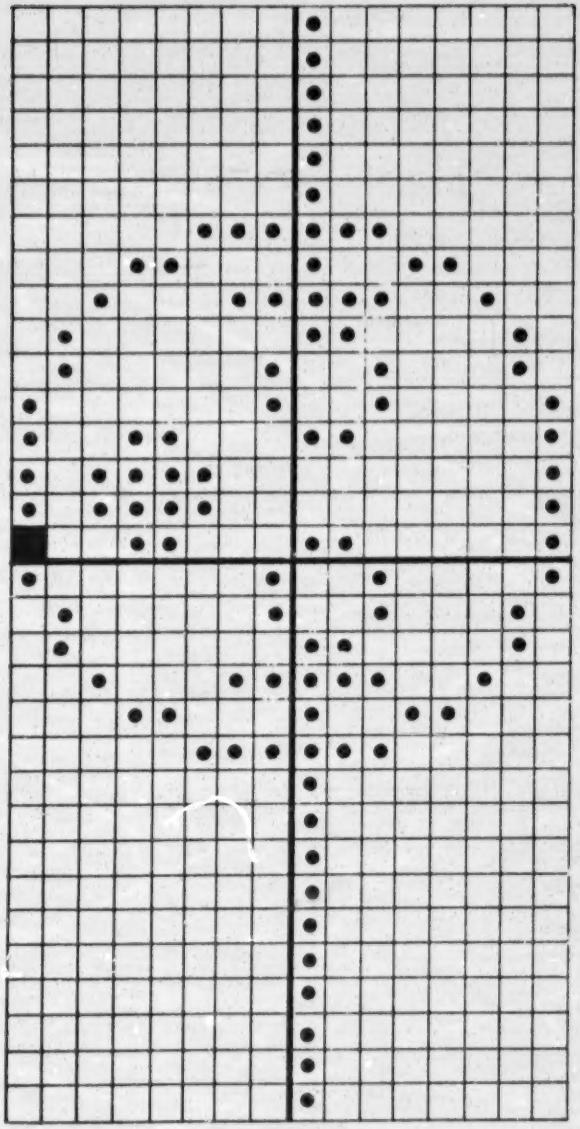
SYMBOL: horizontal lamp

SYMBOL NAME: h-lamp



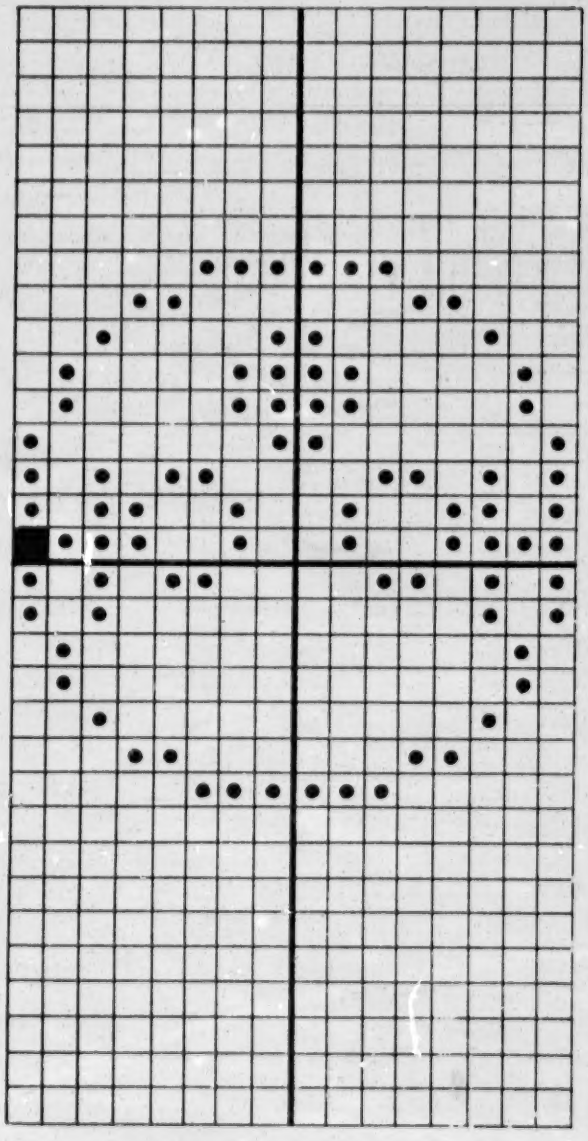
SYMBOL: vertical neon lamp

SYMBOL NAME: v-neon



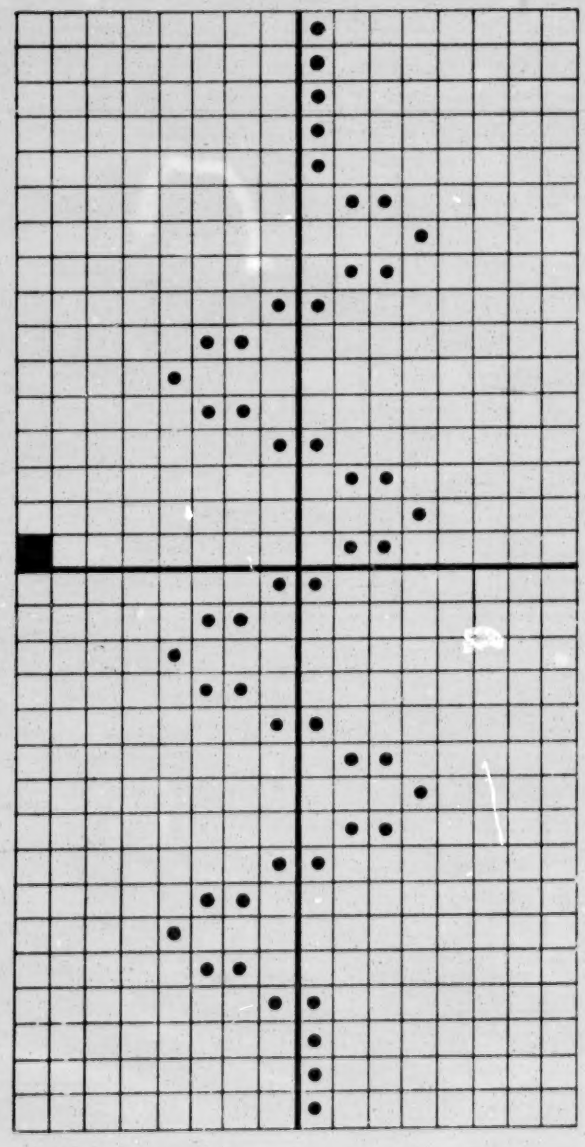
SYMBOL: horizontal neon lamp

SYMBOL NAME: h-neon



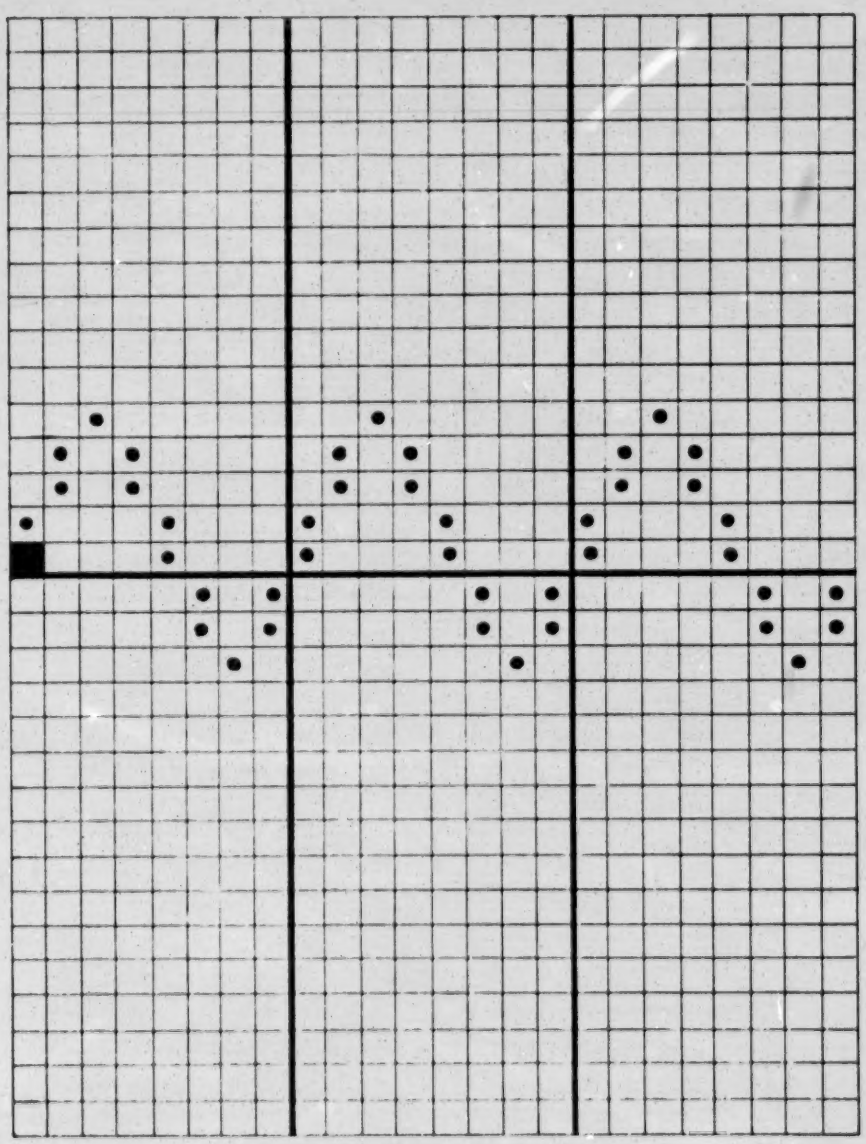
SYMBOL: vertical resistor

SYMBOL NAME: v-res



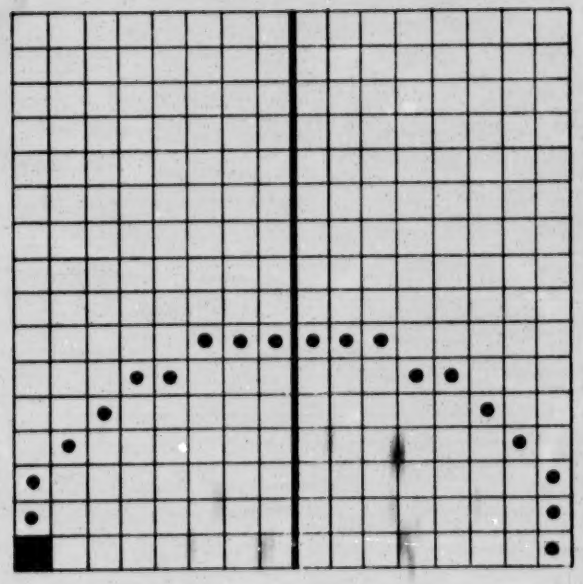
SYMBOL: horizontal resistor

SYMBOL NAME: h-res



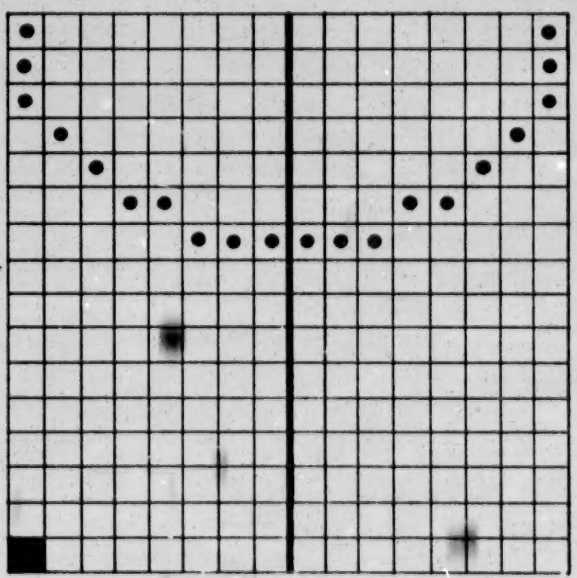
SYMBOL: horizontal transformer, coil up

SYMBOL NAME: h-tranl



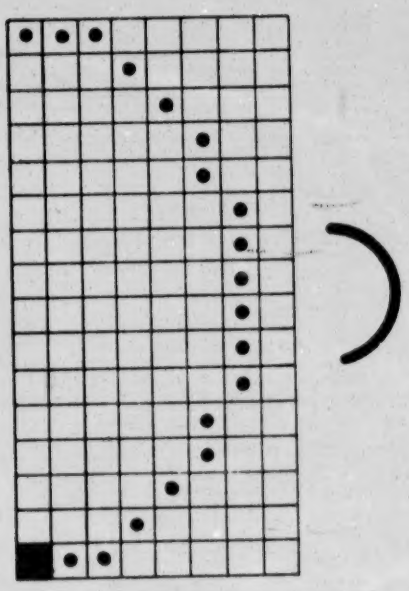
SYMBOL: horizontal transformer, coil down

SYMBOL NAME: h-tran2



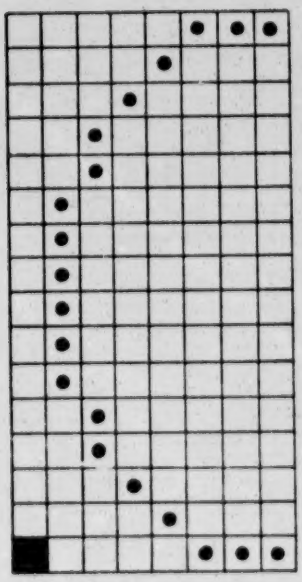
SYMBOL: vertical transformer, coil right

SYMBOL NAME: vl-tran



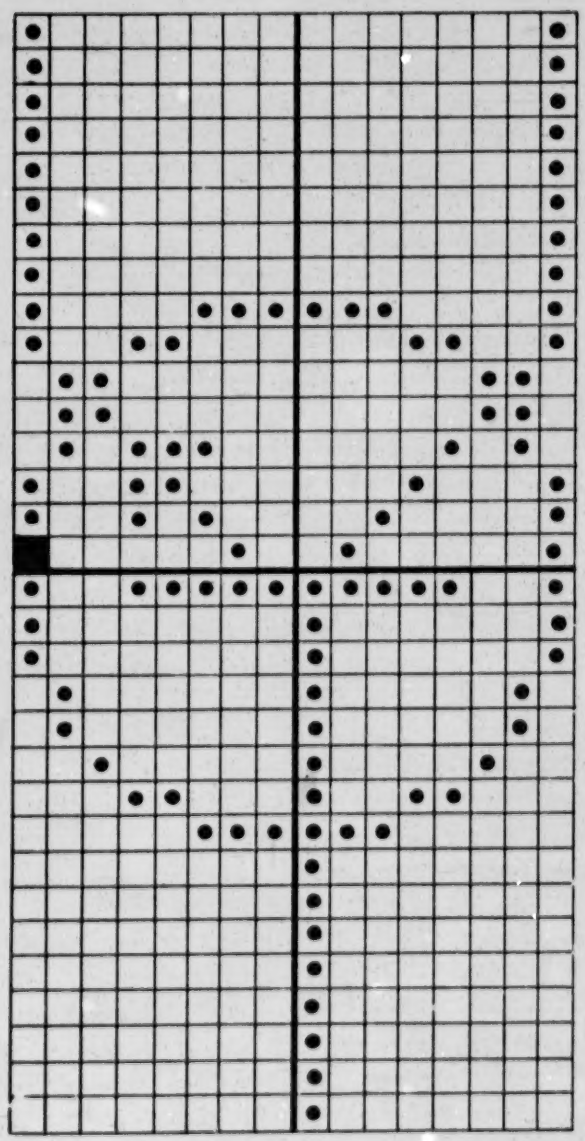
SYMBOL: vertical transformer, coil left

SYMBOL NAME: vr-tran



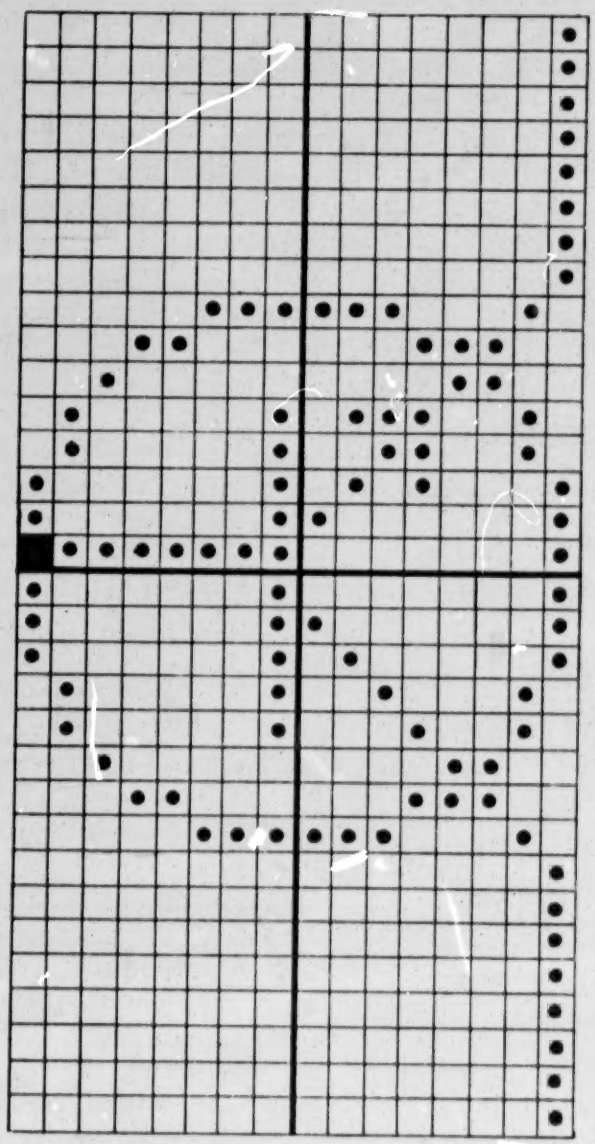
SYMBOL: NPN transistor, base down

SYMBOL NAME: npn-1



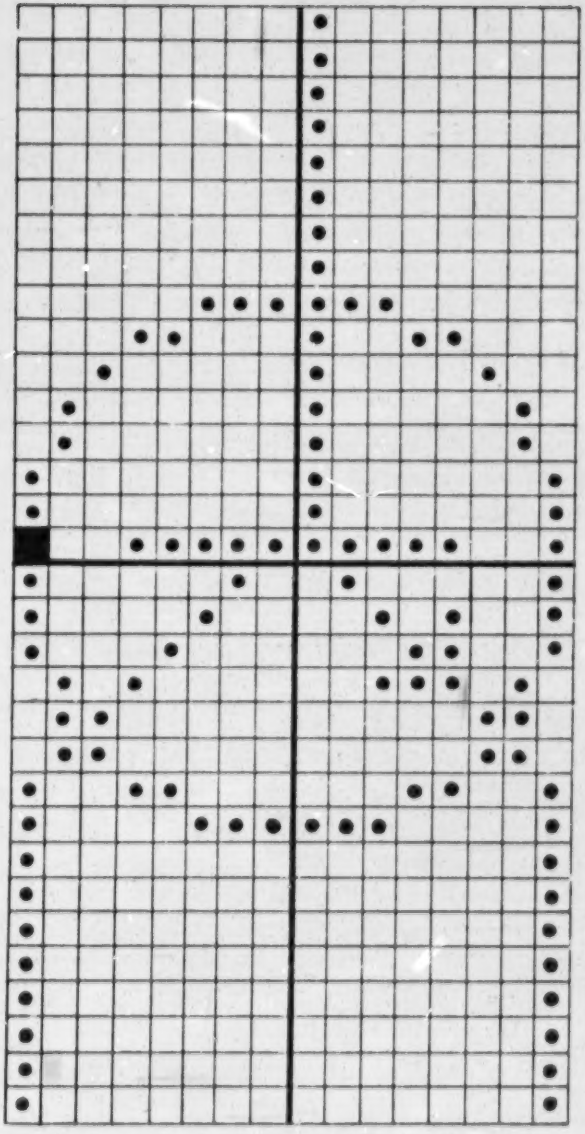
SYMBOL: NPN transistor, base left

SYMBOL NAME: npn-2



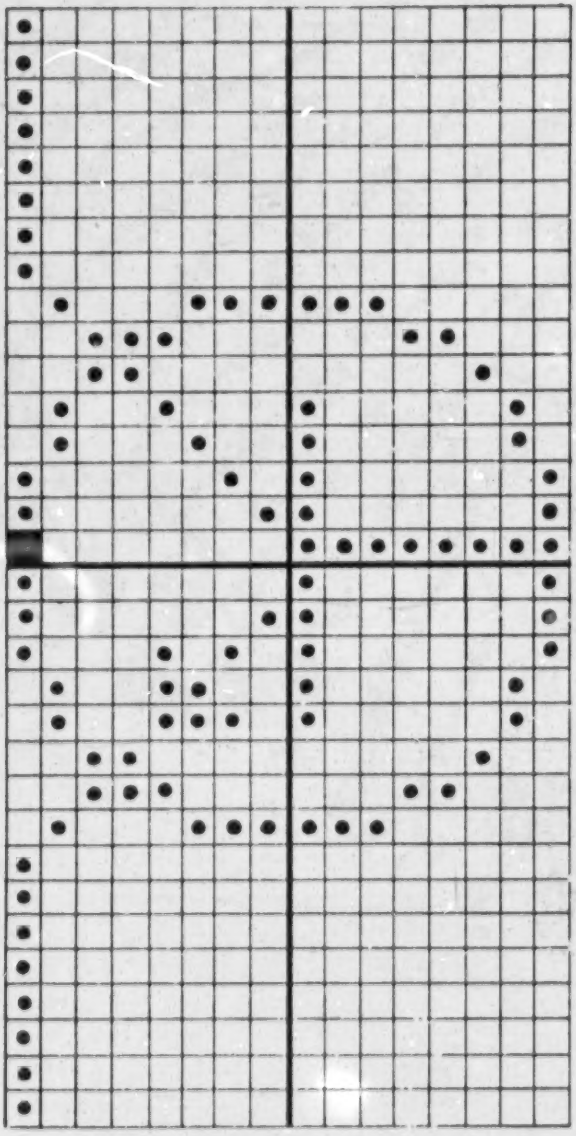
SYMBOL: NPN transistor, base up

SYMBOL NAME: npn-3



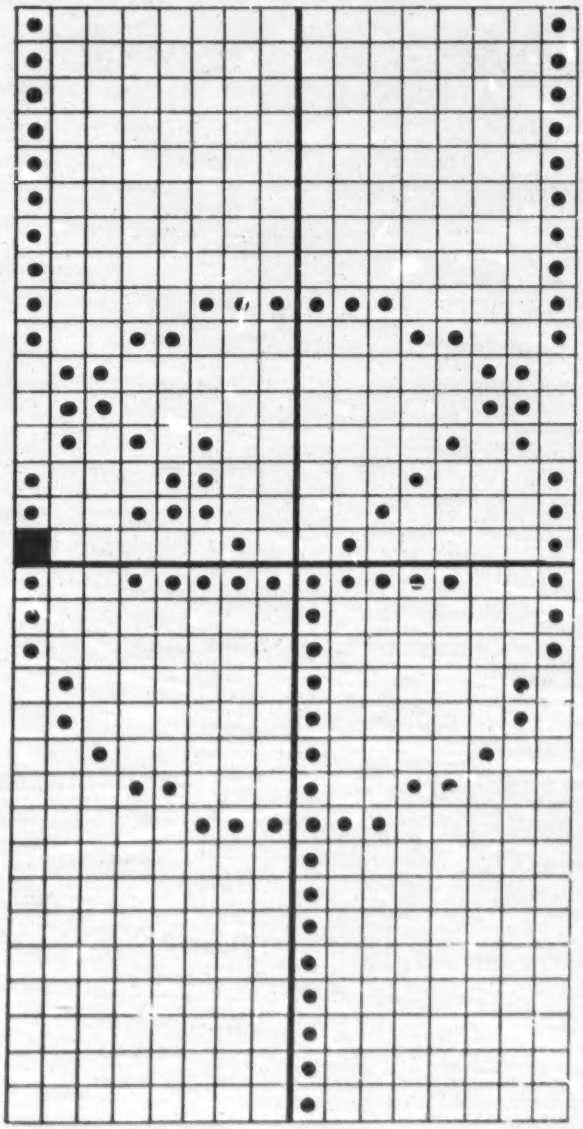
SYMBOL: NPN transistor, base right

SYMBOL NAME: npn-4



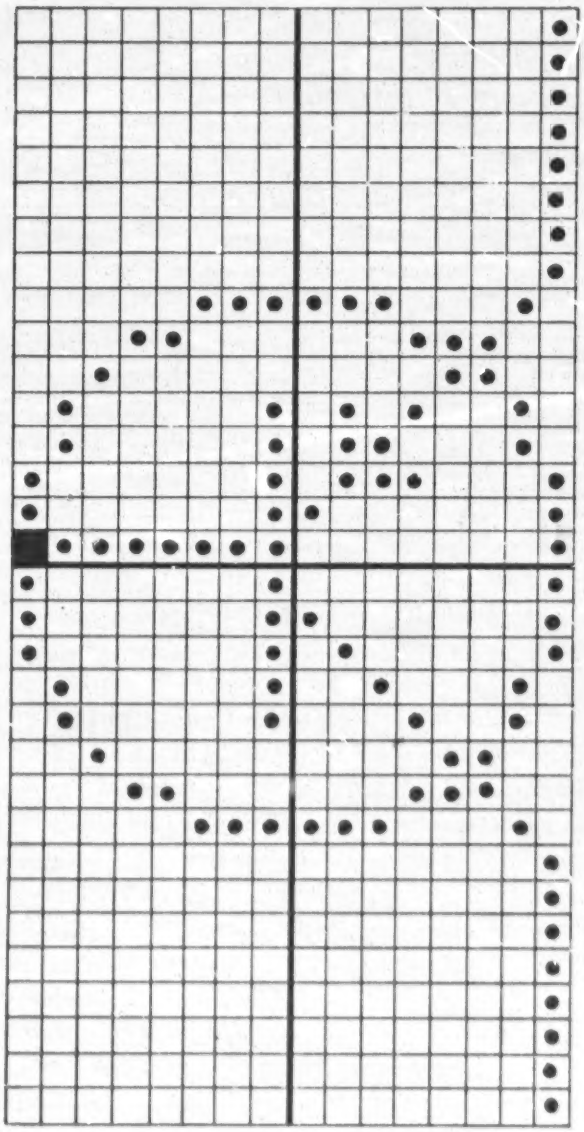
SYMBOL: PNP transistor, base down

SYMBOL NAME: pnp-1



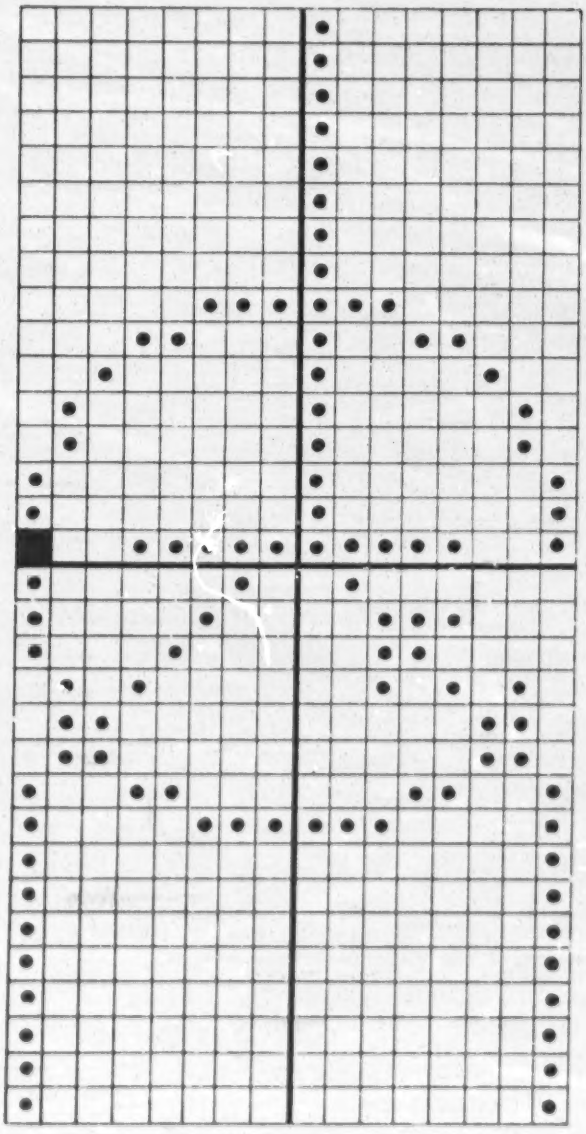
SYMBOL: PNP transistor, base left

SYMBOL NAME: pnp-2



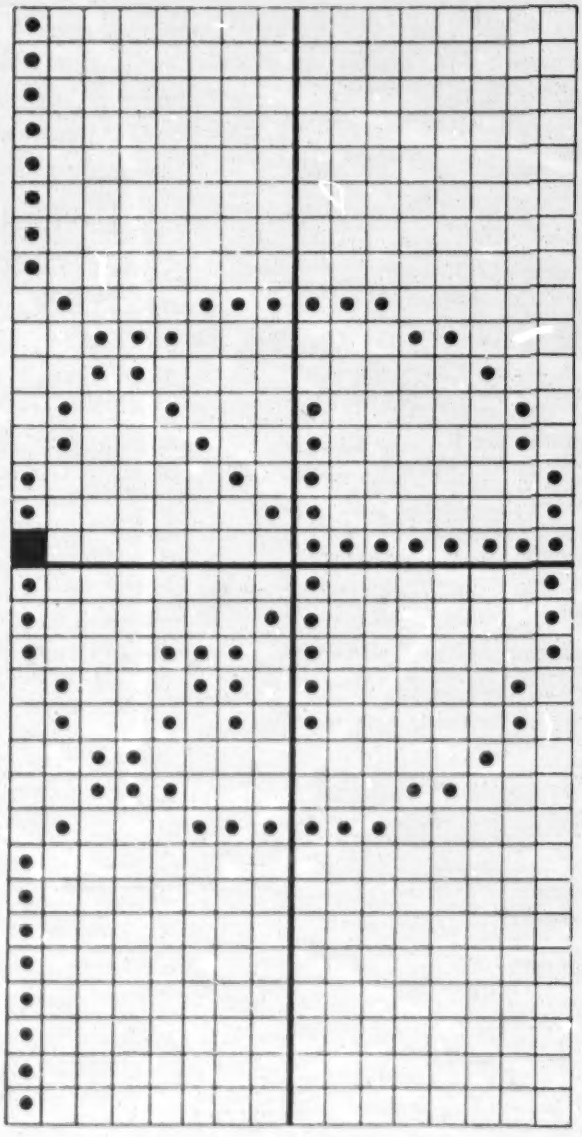
SYMBOL: PNP transistor, base up

SYMBOL NAME: pnp-3



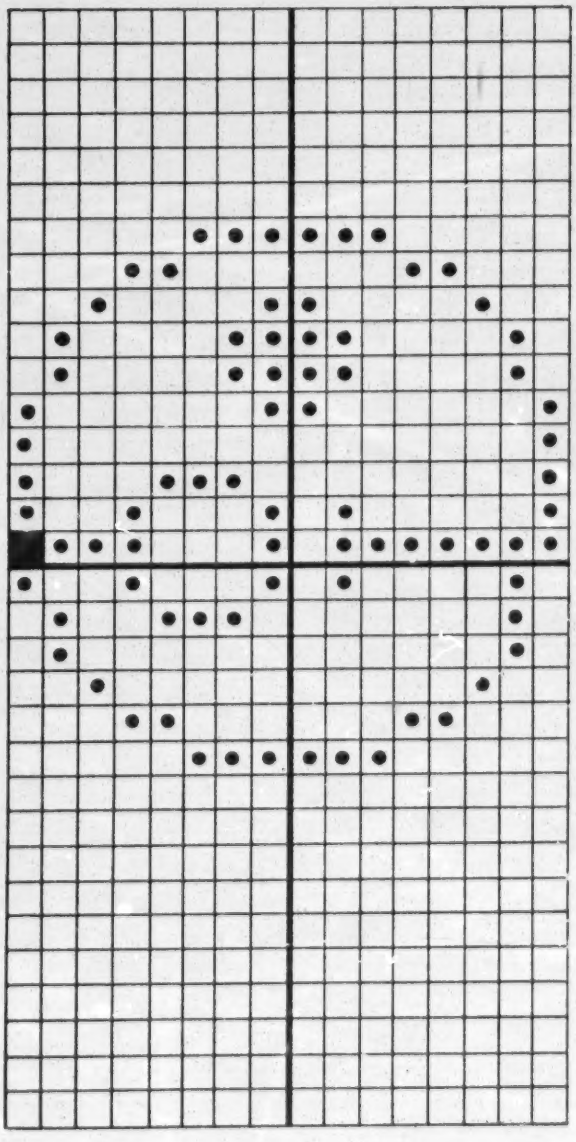
SYMBOL: PNP transistor, base right

SYMBOL NAME: pnp-4



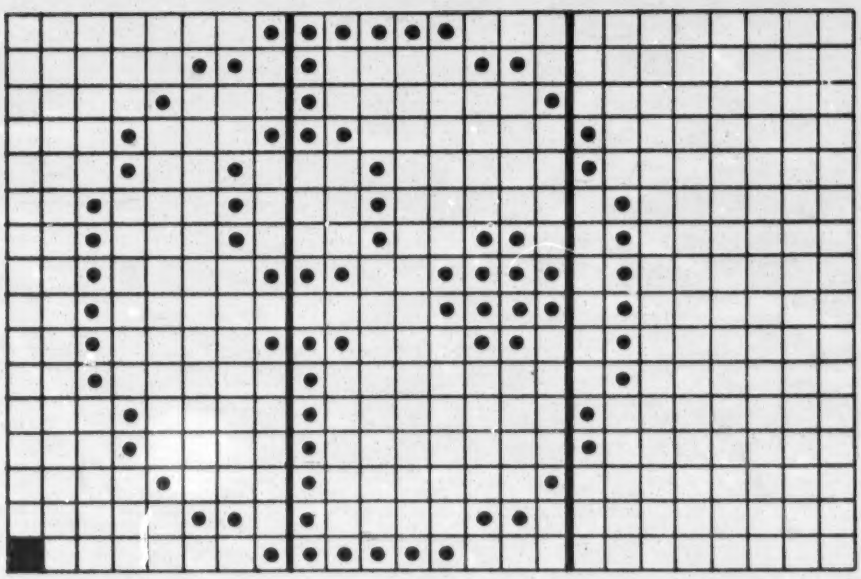
SYMBOL: horizontal gas tube

SYMBOL NAME: hg-tube



SYMBOL: vertical gas tube

SYMBOL NAME: vg-tube



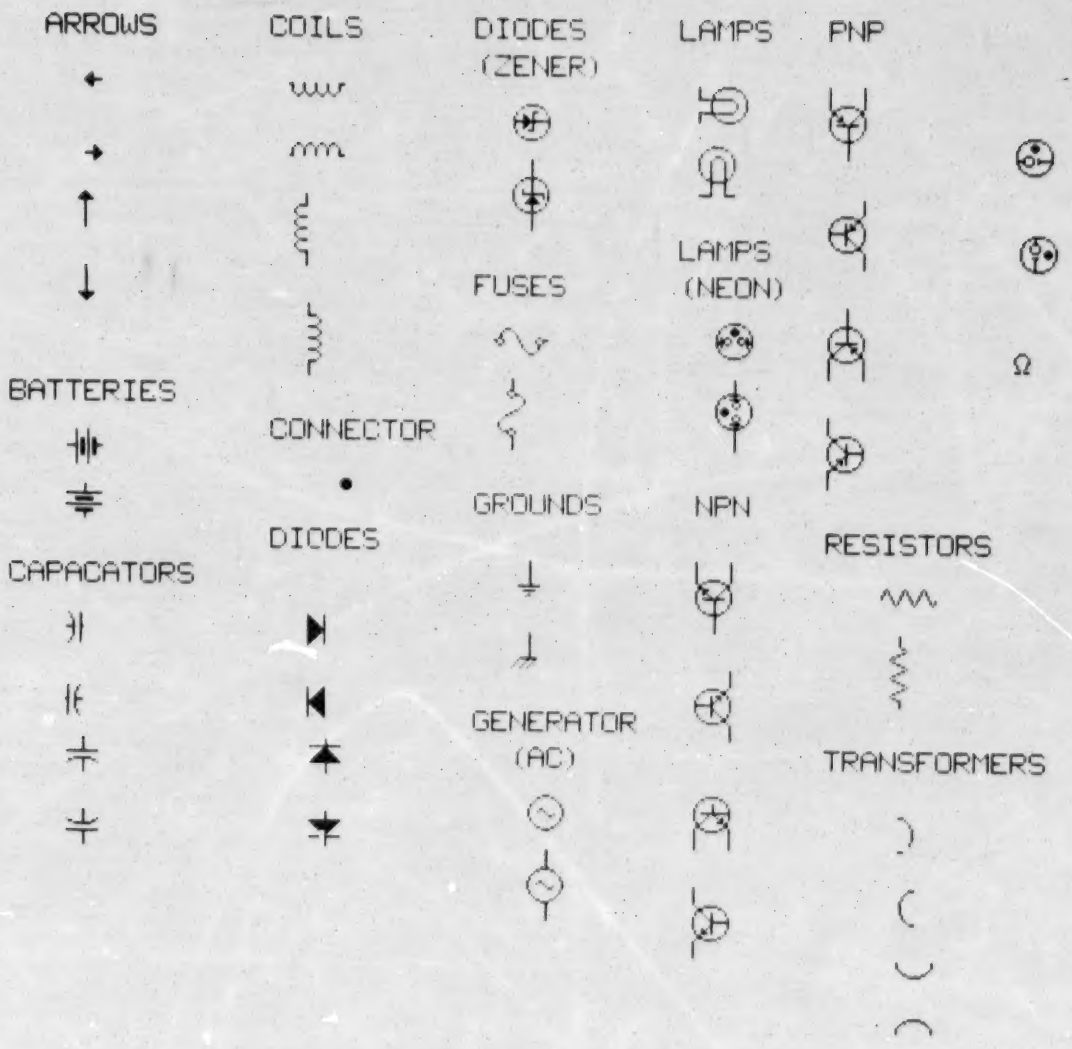

ARROWS
COILS
DIODES (ZENER)
LAMPS
PNP
BATTERIES
FUSES
LAMPS (NEON)
Ω
CONNECTOR
GROUNDS
NPN
RESISTORS
DIODES
CAPACATORS
GENERATOR (AC)
TRANSFORMERS

Figure 2

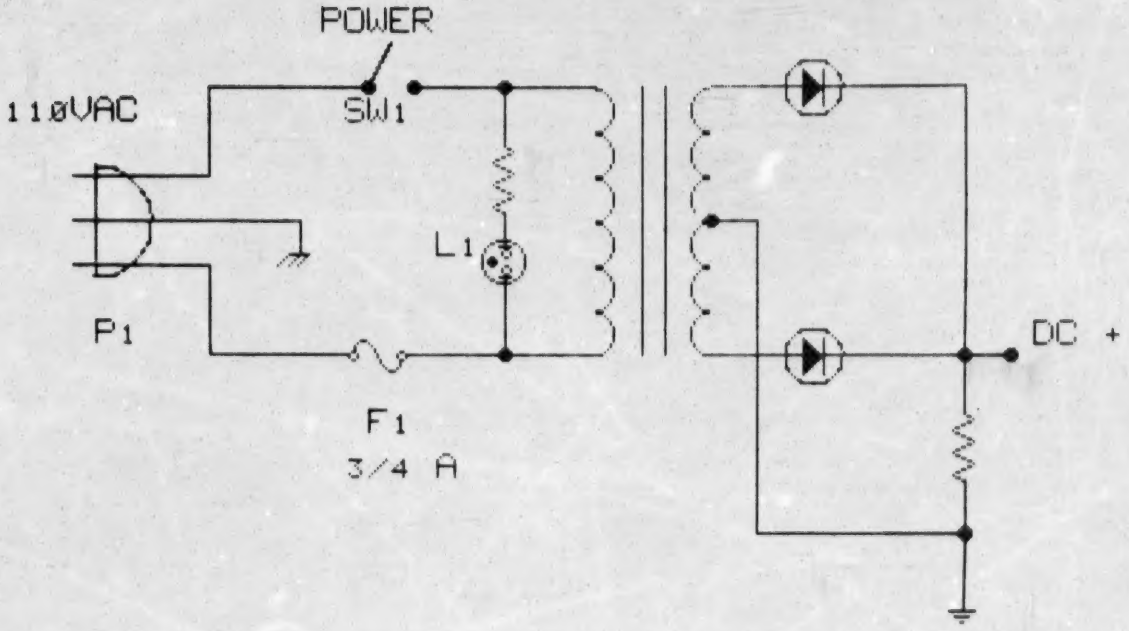


Figure 3